Optical disk drive, and method for identifying optical disks mounted thereto

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Abstract of **EP1191529**

An optical disk drive comprising: wobble signal reproduction means for reproducing, in the state where each of mounted optical disks is rotated at a predetermined rotation speed, a signal corresponding to groove wobbles from a predetermined position in a radial direction of the optical disk, plural filter means for extracting each of plural frequency components corresponding to the frequencies of the groove wobbles of the plural kinds of recording-capable optical disks; and disk identification means for identifying a kind of the mounted optical disk, based on the output signals from the plural filter means.

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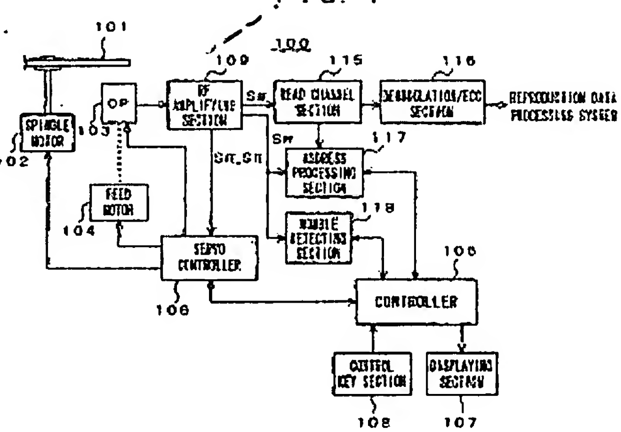

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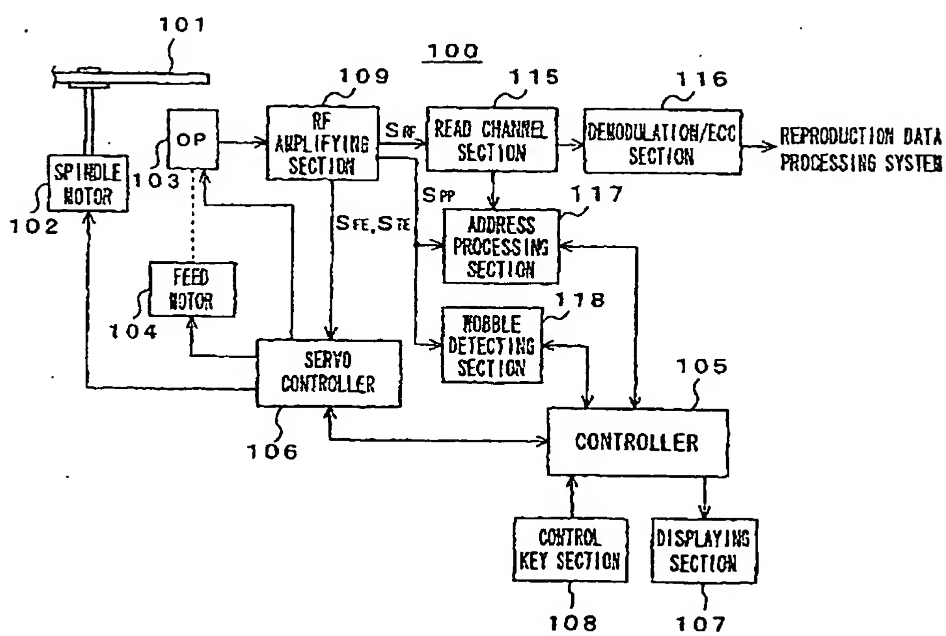
(54) **Optical disk drive, and method for identifying optical disks mounted thereto**

(57) An optical disk drive comprising:

wobble signal reproduction means for reproducing, in the state where each of mounted optical disks is rotated at a predetermined rotation speed, a signal corresponding to groove wobbles from a predetermined position in a radial direction of the optical disk, plural filter means for extracting each of plural frequency components corresponding to the frequencies of the groove wobbles of the plural kinds of recording-capable optical disks; and
disk identification means for identifying a kind of the mounted optical disk, based on the output signals from the plural filter means.

FIG. 1



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radiated onto the photodetector which constitutes the optical pickup 103.

[0012] The drive 100 also includes: a controller 105 for controlling the operations of the entire drive; and a servo controller 106. To the controller 105, connected are a displaying section 107 constituted by a liquid crystal element and the like, and a control key section 108 provided with plural control keys. The servo controller 106 controls the tracking and focus at the optical pickup 103, and also controls the operation of the feed motor 104. The servo controller 106 also controls the rotation of the spindle motor 102. The optical disk 101 is driven to rotate at a constant linear velocity (CLV) at the time of recording and reproducing.

[0013] The drive 100 further includes an RF amplifying section 109 for processing an output signal from the photodetector which constitutes the optical pickup 103 so as to produce a reproduction RF signal S_{RF}, a focus error signal S_{FE}, a tracking error signal S_{TE}, and a push-pull signal S_{PP}. In this case, the focus error signal S_{FE} is produced in an astigma method (i.e. an astigmatism method). The tracking error signal S_{TE} is produced by a DPD method (i.e. a digital phase difference method) when reproduced, and is produced by a push-pull method when recorded.

[0014] The focus error signal S_{FE} and the tracking error signal S_{TE} which are produced in the RF amplifying section 109 are supplied to the servo controller 106. The servo controller 106 controls the tracking and focus at the optical pickup 103 by use of these error signals as described above.

[0015] As the photodetector which constitutes the optical pickup 103, a quadrant photodetector PD is used as shown in Fig. 2. In the photodetector PD, a spot SP is formed by the light returned from the optical disk 101. Defining detection signals of four photodiodes Da to Dd which constitute together the photodetector PD as Sa to Sd, the push-pull signal S_{PP} can be obtained from the following calculation.

[0016] Specifically, the detection signals Sa, Sc are added in an adder 111, and simultaneously, the detection signals Sb, Sd are added in an adder 112. Then, a subtracter 113 subtracts an output signal from the adder 112 from the output signal from the adder 111 to obtain the push-pull signal S_{PP}.

[0017] Returning to Fig. 1, the drive 100 also includes: a read channel section 115 for performing a series of analog signal processings including the binary slice for the reproduction RF signal produced in the RF amplifying section 109, the production of synchronous data by the subsequent phase-locked loop (PLL), and the like; and a demodulation/ECC section 109 for performing processings including the demodulation of the synchronous data (8/16 modulation data) produced in the read channel section 108, the subsequent error correction, and the like. The output data from the demodulation/ECC section 109 is supplied to an unillustrated reproduction data processing system.

[0018] The drive 100 further includes an address processing section 117. The address processing section 117 transfers to the controller 115 the address information extracted from the reproduction RF signal S_{RF} in the read channel section 115. The address processing section 117 also processes the push-pull signal S_{PP} to obtain address information, and transfers the address information to the controller 105.

[0019] The drive 100 also includes a wobble detection section 118 for detecting wobble signals from the push-pull signal S_{PP} produced in the RF amplifying section 109. Fig. 3 shows a structure of the wobble detecting section 118.

[0020] The wobble detecting section 118 includes a first bandpass filter 121 having a center frequency f1 of 140kHz, and a second bandpass filter 122 having a center frequency f2 of 810kHz.

[0021] In the case where the optical disk 101 is a DVD-RW disk as an optical disk of a first kind, if the optical disk 101 is driven to rotate at a rotation speed of 1389rpm, the frequency of the groove wobble at the position of 24mm in a radial direction thereof is about 140kHz. Therefore, the push-pull signal S_{PP} in this case has high level of frequency component of about 140kHz.

[0022] In the case where the optical disk 101 is a DVD+RW disk as an optical disk of a second kind, if the optical disk 101 is driven to rotate at a rotation speed of 1389rpm, the frequency of the groove wobble at the position of 24mm in a radial direction thereof is about 810kHz. Therefore, the push-pull signal S_{PP} in this case has high level of frequency component of about 810kHz.

[0023] The wobble detecting section 118 includes: a first level detecting section 123 for detecting the amplitude level of the output signal SF1 from the first bandpass filter 121; and a second level detecting section 124 for detecting the amplitude level of the output signal SF2 from the second bandpass filter 122. Each of these first and second level detecting sections 123, 124 is constituted by a rectifying and smoothing circuit, for example,

[0024] The wobble detecting section 118 includes: a first sample hold circuit 125 for sampling the output signal from the first level detecting section 123 by a sample pulse SMP supplied from the controller 105 at a predetermined timing and then for holding the sample value as a detection level LV1; and a second sample hold circuit 126 for sampling the output signal from the second level detecting section 124 by the above-described sample pulse SMP and then for holding the sample value as a detection level LV2.

[0025] The wobble detecting section 118 further includes: a first A/D converter 127 for converting the detection level LV1 held in the first sample hold circuit 125 into a digital signal, and then for supplying thus-produced digital signal to the controller 105; and a second A/D converter 128 for converting the detection level LV2 held in the second sample hold circuit 126 into a digital signal, and then for supplying thus-produced digital signal to the controller 105.

hibition, this state can be acknowledged immediately.

[0036] In addition, in the embodiment of the present invention, when the mounted optical disk 101 is a recording-capable optical disk, the kind of the disk can be known simultaneously. Due to this arrangement, the possibility of erroneous recording into not-corresponding optical disk can be lowered.

[0037] In the embodiment described above, the wobble detecting section 118 has a structure such as shown in Fig. 3. Alternatively, the wobble detecting section 118 may have a structure such as shown in Fig. 5. In Fig. 5, the constituent elements identical to those of Fig. 3 are denoted by the same reference numerals, and descriptions thereof will be omitted.

[0038] As is the case of the wobble detecting section 118 shown in Fig. 3, the wobble detecting section 118 includes: a first bandpass filter 121 having a center frequency f1 of 140kHz; and a second bandpass filter 122 having a center frequency f2 of 810kHz.

[0039] The wobble detecting section 118 also includes: a first binary circuit 131 for binarizing the output signal SF1 from the first bandpass filter 121; a second binary circuit 132 for binarizing the output signal SF2 from the second bandpass filter 122; a first PLL circuit 133 for producing a frequency signal FO1 using the binary signal from the first binary circuit 131 as a reference signal, and then for supplying the frequency signal FO1 to the controller 105; and a second PLL circuit 134 for producing a frequency signal FO2 using the binary signal from the second binary circuit 132 as a reference signal, and then for supplying the frequency signal FO2 to the controller 105.

[0040] At the time of identifying the mounted optical disk 101, the wobble detecting section 118 processes the push-pull signal S_{PP} to produce the frequency signals FO1, FO2, and supplies the frequency signals FO1, FO2 to the controller 105.

[0041] Specifically, the first bandpass filter 121 extracts the frequency component of about 140kHz from the push-pull signal S_{PP}. Then, the first binary circuit 131 binarizes the output signal SF1 from the first filter 121. The binary signal from the first binary circuit 131 is supplied to the first PLL circuit 133 as a reference signal. Then, the frequency signal FO1 output from the first PLL circuit 133 is supplied to the controller 105.

[0042] In this case, when the frequency component of about 140kHz of the output signal SF1 from the first bandpass filter 121 is at high level, the binary signal supplied to the first PLL circuit 133 has a single frequency of about 140kHz. As a result, a frequency signal of about 140kHz can be obtained as a frequency signal FO1. Contrary to this, when the frequency component of about 140kHz of the output signal SF1 from the first bandpass filter 121 is at low level, the binary signal supplied to the first PLL circuit 133 does not has a single frequency of about 140kHz because of noise components. As a result, it is impossible to obtain a frequency signal of about 140kHz as a frequency signal FO1.

[0043] Similarly, the second bandpass filter 122 extracts the frequency component of about 810kHz from the push-pull signal S_{PP}. Then, the second binary circuit 132 binarizes the output signal SF1 from the second filter 122. The binary signal from the second binary circuit 132 is supplied to the second PLL circuit 134 as a reference signal. Then, the frequency signal FO2 output from the second PLL circuit 134 is supplied to the controller 105.

[0044] In this case, when the frequency component of about 810kHz of the output signal SF1 from the second bandpass filter 122 is at high level, the binary signal supplied to the second PLL circuit 134 has a single frequency of about 810kHz. As a result, a frequency signal of about 810kHz can be obtained as a frequency signal FO2. Contrary to this, when the frequency component of about 810kHz of the output signal SF2 from the second bandpass filter 122 is at low level, the binary signal supplied to the second PLL circuit 134 does not has a single frequency of about 810kHz because of noise components. As a result, it is impossible to obtain a frequency signal of about 810kHz as a frequency signal FO2.

[0045] The controller 105 performs the identification of the mounted optical disk 101 in the following manner by use of the frequency signals FO1, FO2. Specifically, in the case where the frequency signal FO1 is a frequency signal of about 140Hz, the mounted optical disk 101 is identified as a DVD-RW disk which is a recording-capable disk. In the case where the frequency signal FO2 is a frequency signal of about 810kHz, the mounted optical disk 101 is identified as a DVD+RW disk which is a recording-capable disk. Furthermore, in the case where the frequency signal FO1 is not a frequency signal of about 140kHz and the frequency signal FO2 is not a frequency signal of about 810kHz, the mounted optical disk 101 is identified as a DVD-ROM disk which is a reproduction only disk.

[0046] For example, the controller 105 determines the frequencies of the frequency signals FO1, FO2 by counting the periods of the frequency signals FO1, FO2 by use of a clock with crystal quartz accuracy. For example, when the periods of the frequency signals FO1, FO2 are counted by a clock of 100MHz and the counted value falls within the range of 118 to 129, the frequency of the frequency signal FO2 falls within the range of 775.2kHz to 847.5kHz. Since this value is ±5% of 810kHz, the controller 105 determines that the frequency of the frequency signal FO2 is about 810kHz. The reason why the deviation of ±5% is allowed is to accommodate the deviations in the position where the measurement is conducted, the number of rotations, and the like in the optical disk 101. Although detailed values are not shown, the deviation of ±5% is similarly allowed in the case of determining the frequency of the frequency signal FO1.

[0047] When a DVD-RW disk is mounted as the optical disk 101, the push-pull signal S_{PP} has high level of

wobble signal of a wobble groove formed on the optical disk, based on the reflected light received by the optical head;
a frequency detector for detecting a frequency of an output signal obtained from the wobble signal reproducer; and
a disk identifier for identifying a kind of the mounted optical disk, based on an output signal obtained from the frequency detector.

7. The optical disk drive according to claim 6, wherein the optical disk identifier identifies the kind of the optical disk, based on the output signal from the frequency detector which has been obtained based on a wobble signal obtained in the state where the spindle motor is controlled to rotate at a predetermined rotation speed by the controller and the optical head is shifted toward a predetermined radial position of the optical disk by the feed mechanism.

8. The optical disk drive according to claim 6, wherein the frequency detector comprises plural filters for extracting frequency components corresponding to the frequencies of the plural kinds of recording-capable optical disks from the output signal from the wobble signal reproducer.

9. The optical disk drive according to claim 8, wherein the disk identifier comprises level detecting sections for detecting each of the levels of the output signals from the plural filters, and conducts identification using the detection signals from the level detecting section.

10. The optical disk drive according to claim 8, wherein the disk identifier comprises a PLL circuit to which the levels of output signals from the plural filters are supplied as reference signals, and conducts identification using the detection signals from the PLL circuit.

11. The optical disk drive according to claim 8, wherein the disk identifier identifies whether or not the mounted optical disk is a recording-capable optical disk, based on the output signals from the plural filters.

12. The optical disk drive according to claim 8, wherein the disk identifier identifies whether the mounted optical disk is a first recording-capable optical disk having a first wobble frequency, or a second recording-capable optical disk having a second wobble frequency.

13. A method for identifying an optical disk, comprising the steps of:

reproducing, in the state where a mounted optical disk is rotated at a predetermined rotation speed, a signal corresponding to a groove wobble from a predetermined position in a radical direction of the optical disk;
extracting each of plural frequency components corresponding to the frequencies of the groove wobbles of plural kinds of recording-capable optical disks; and
identifying whether or not the mounted optical disk is a recording-capable optical disk, based on the output signals from the plural filter means.

FIG. 2

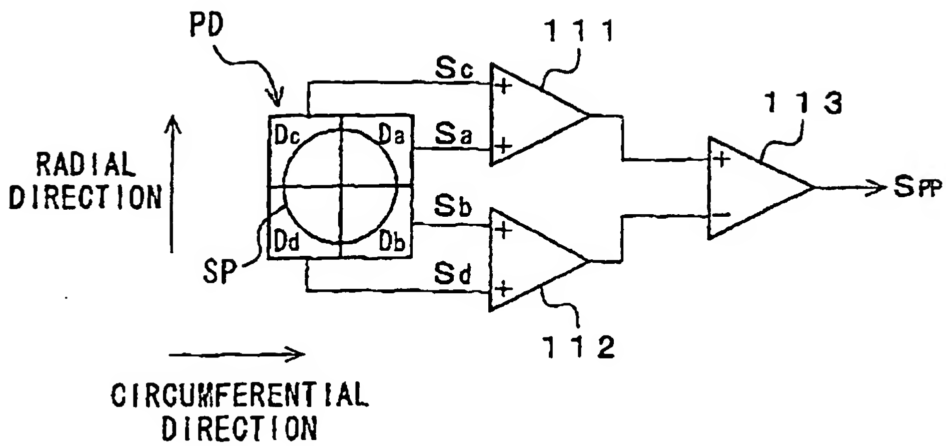
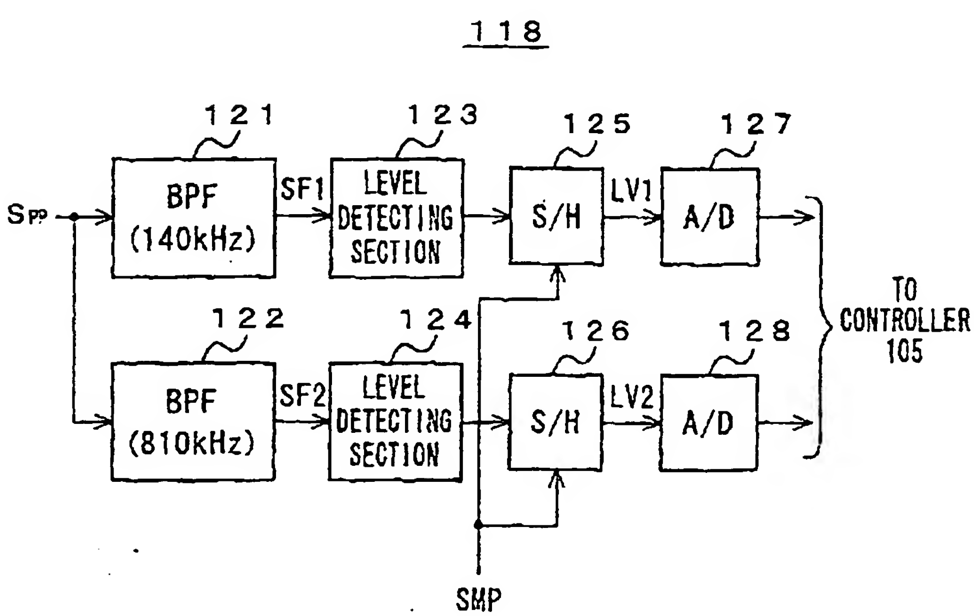

PD
111
113
Sc
Sa
Sb
Sd
Dc
Da
Dd
Db
RADIAL DIRECTION
SP
SPP
112
CIRCUMFERENTIAL DIRECTION

FIG. 3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121
123
125
127
SPP
BPF (140kHz)
SF1
LEVEL DETECTING SECTION
S/H
LV1
A/D
122
124
126
128
TO CONTROLLER 105
BPF (810kHz)
SF2
LEVEL DETECTING SECTION
S/H
LV2
A/D
SMP

FIG. 5

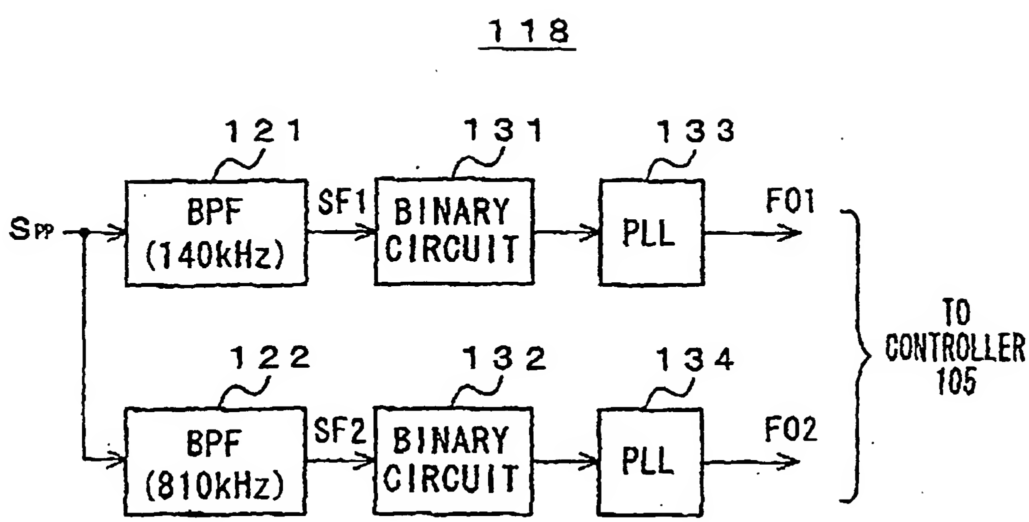
118
121
131
133
SPP
BPF (140kHz)
SF1
BINARY CIRCUIT
PLL
F01
TO CONTROLLER 105
122
132
134
BPF (810kHz)
SF2
BINARY CIRCUIT
PLL
F02

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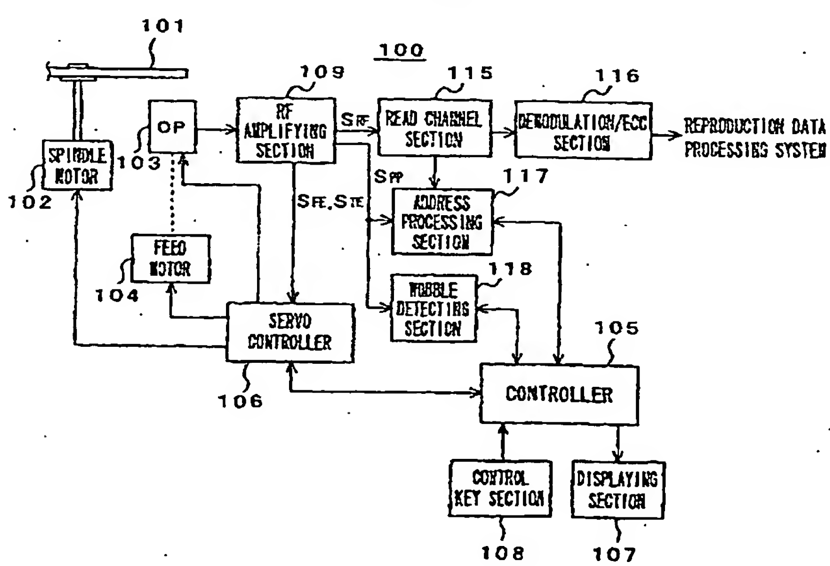
FIG. 1



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